Nitric acid/ozone correlations as a tool for validating Aura MLS nitric acid retrievals in the upper troposphere and lower stratosphere

Peter J. Popp

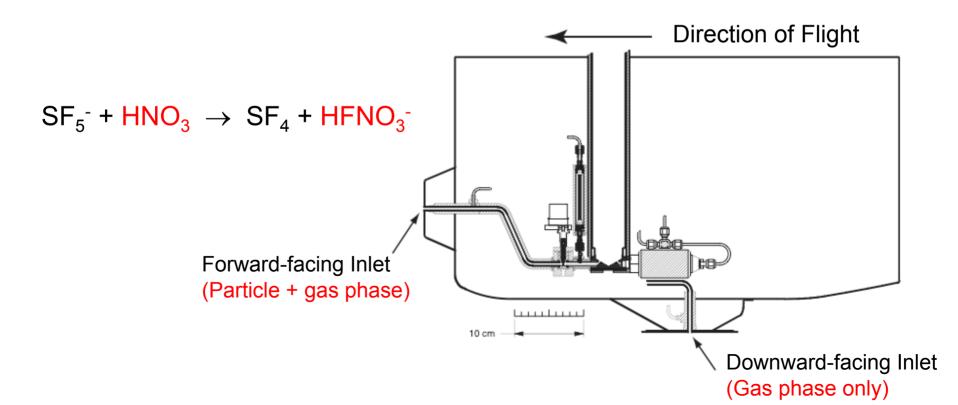**Chemical Sciences Division, NOAA Earth Systems Research Laboratory**

T.P. Marcy, R.S. Gao, L.A. Watts, D.W. Fahey, E.C. Richard, S.J. Oltmans, M.L. Santee, B. Sen, G.C. Toon
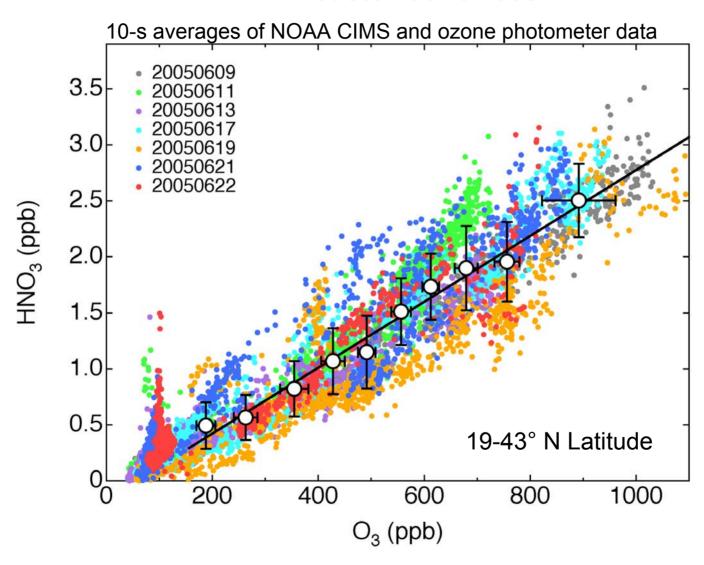
NOAA CIMS instrument

- Two independent channels of detection allow us to measure both gas- and particle-phase HNO_3

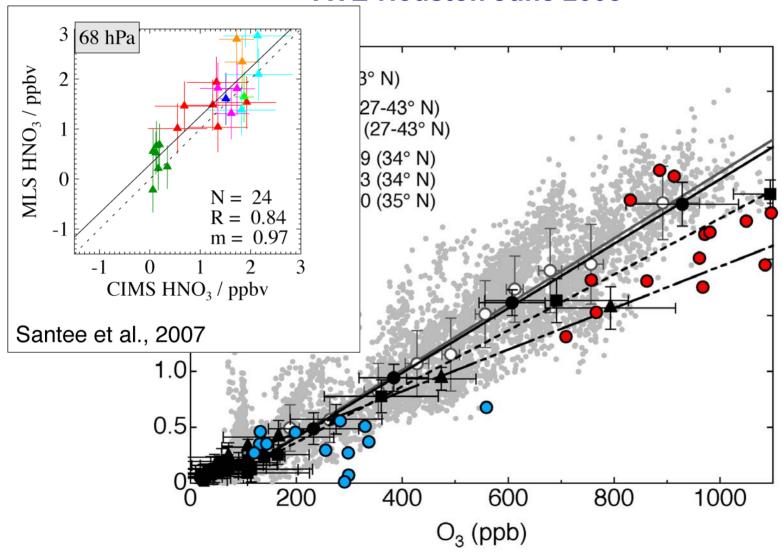- Precision: 40 pptv (1σ at 1 second)
  Accuracy: 25%

$$SF_5^- + HNO_3 \rightarrow SF_4 + HFNO_3^-$$

Direction of Flight

Forward-facing Inlet
(Particle + gas phase)

10 cm

Downward-facing Inlet
(Gas phase only)

Nitric acid/ozone correlation in the UT/LS
AVE-Houston June 2005

10-s averages of NOAA CIMS and ozone photometer data

19-43° N Latitude

Nitric acid/ozone correlation in the UT/LS
AVE-Houston June 2005

Santee et al., 2007
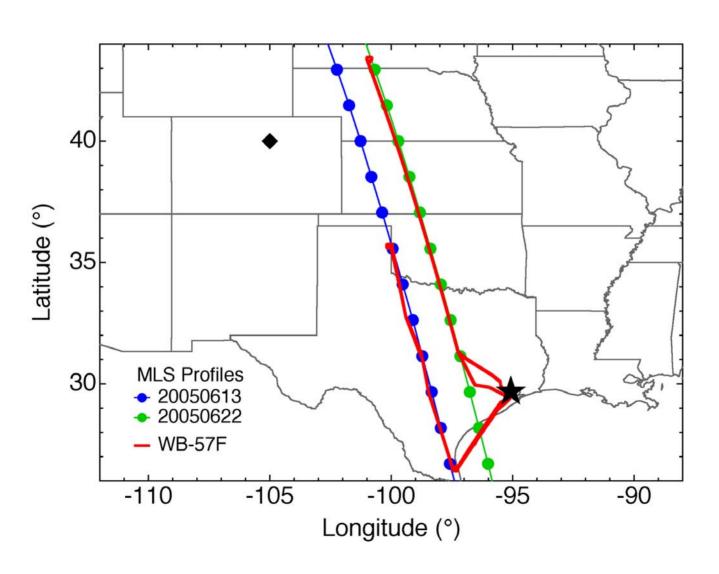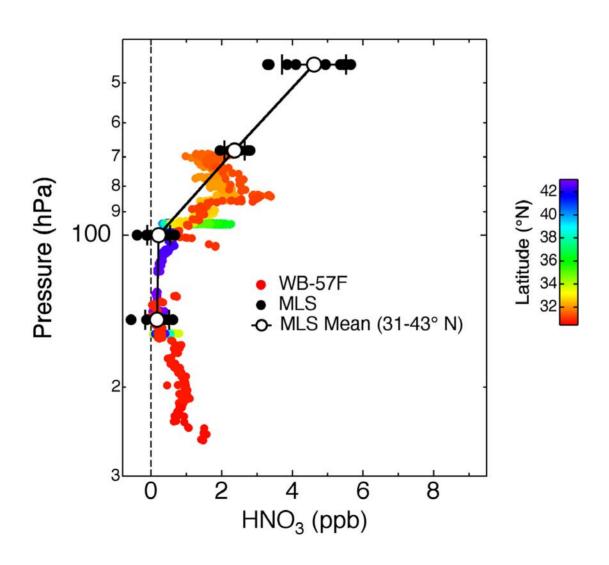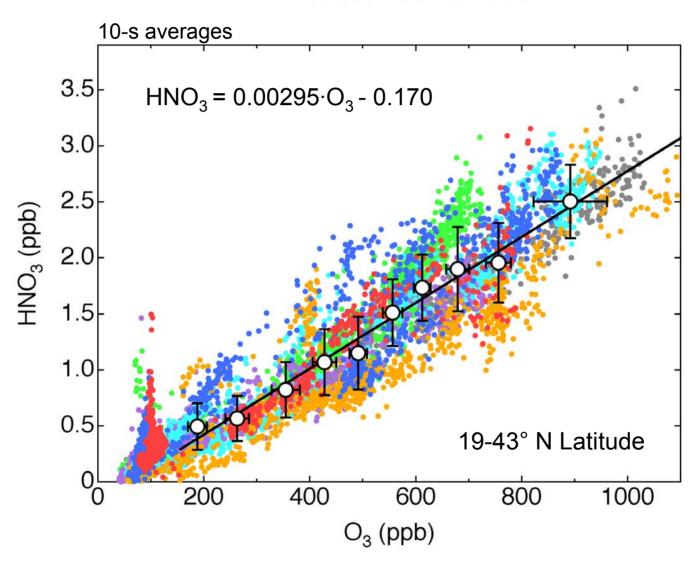
Aura MLS and WB-57F flight tracks
AVE-Houston June 2005

Nitric acid vertical profiles
AVE-Houston 22 June 2005
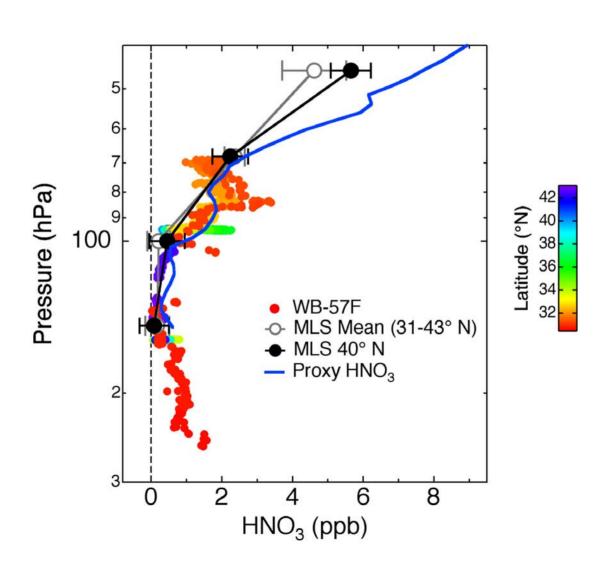
Calculating proxy nitric acid
AVE-Houston June 2005

10-s averages

$HNO_3 = 0.00295 \cdot O_3 - 0.170$

HNO$_3$ (ppb)

O$_3$ (ppb)

19-43° N Latitude

Nitric acid vertical profiles
AVE-Houston June 2005
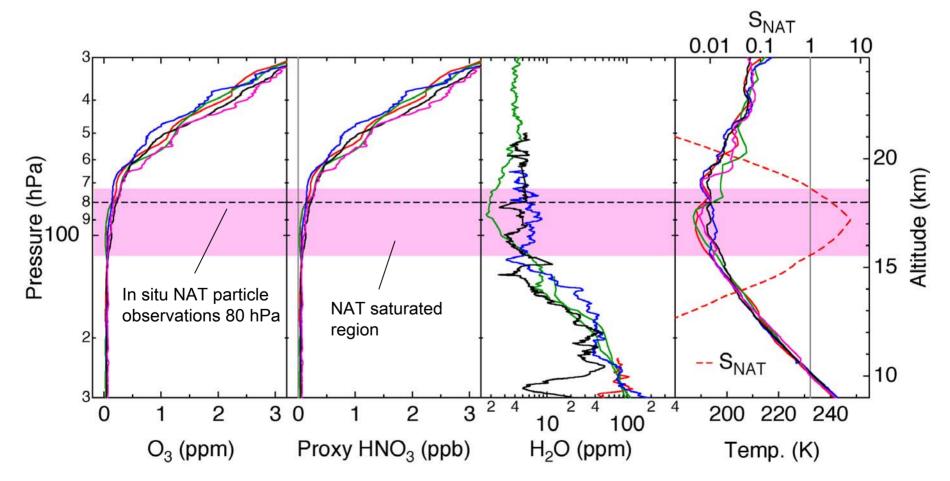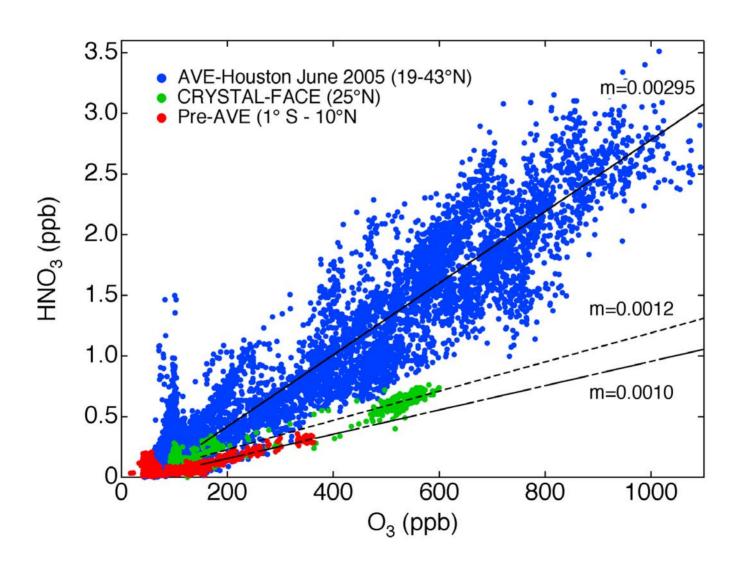
Using proxy nitric acid to calculate NAT saturation conditions in the tropics

Pre-AVE Costa Rica January 2004

Ozone and temperature: San Cristobal (1° S) and Paramaribo (6° N)
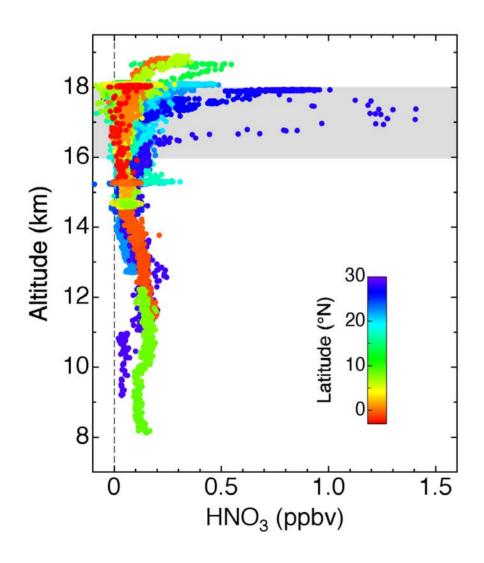Water vapor: San Cristobal (1° S) and San Jose (10° N)

Popp et al., 2006

Latitudinal variations in the nitric acid/ozone correlation

Vertical profiles of nitric acid in the tropics
Pre-AVE Costa Rica January 2005

In situ measurements during the Aura validation campaigns revealed extremely low HNO_3 mixing ratios (<100 pptv) near the tropical tropopause

Conclusions

- HNO_3 and O_3 exhibit a robust and compact correlation in the lower stratosphere

    Strong latitudinal gradients are observed in the correlation slope

- HNO_3/O_3 correlations are a useful tool for the validation of HNO_3 retrievals, particularly when comparing different measurement techniques.

- Proxy HNO_3 mixing ratios derived from the HNO_3/O_3 correlation expand the range of available HNO_3 comparisons when only O_3 data are available

- Comparisons between the HNO_3/O_3 correlations derived from MLS, MkIV and NOAA in situ instruments onboard the WB-57F show acceptable agreement at the 68 and 100 hPa retrieval levels